5.4.4 Fissures

History

Earth fissures are linear cracks in the ground that extend from the groundwater table and are a direct result of subsidence caused by groundwater depletion. The surface expression of fissures ranges from less than a yard to several miles long and from less than an inch to tens of feet wide. The longest fissure is in Pinal County, near Picacho, and is over 10 miles long. Earth fissures occur at the edges of basins, usually parallel to mountain fronts, or above local bedrock highs in the subsurface, and typically cut across drainage. Fissures change flood patterns, break buried pipes and lines, cause infrastructure to collapse, provide a direct conduit to the groundwater table for contaminants thrown into them, and even pose a life safety hazard.

The Basin and Range province that occupies the southern third of Arizona is the primary area that is susceptible to earth fissures; this area encompasses parts of four counties that are particularly prone to earth fissures: Pinal, Maricopa, Cochise and Pima Counties. Pinal County has more fissures than any other county in Arizona. The AZGS combined fissure zones into groups, or planning areas, to facilitate the recent legislative mandate that requires all fissures in Arizona to be mapped and publicly disclosed. These areas are labeled on the county maps on the following pages and broken down in the table below.

Earth Fissure Mapping Areas			
Cochise County		Pinal County	
Sulphur Springs North	Bowie-San Simon	Apache Junction	Toltec Buttes
Three Sisters Buttes	Dragoon Road	Picacho	Heaton
Maricopa County		White Horse Pass	Signal Peak
Wintersburg	Luke AFB	Tator Hills	Greene Wash
Harquahala Plain	Mesa	Sacaton Butte	Pete's Corner
Scottsdale/NE Phoenix		Santa Rosa Wash	
Chandler Heights/ Queen Creek		Chandler Heights/ Queen Creek	
Pima County Marana			

Note: List, by county, of the priority areas for AZGS fissure mapping.
Source: AZGS, 2007.

Fissures have been occurring in Arizona at least since 1927, when the first one was found near Picacho. The number of fissures has increased dramatically since the 1950s because of groundwater depletion, first because of agriculture, and later, because of exponential population growth. The risk posed by fissures is also increasing as the population expands into the outlying basin edges and mountain fronts.

Several fissure case histories are outlined below.

San Tan Mountains, Maricopa and Pinal Counties

- Foothills—undermining at least one home, and crossing several roads; dogs trapped in flash flood flowing through the fissure in 2007.
- Y-crack—crosses the Hunt Highway and San Tan Boulevard east of Sossaman Road; present at least by 1969; catastrophically re-opened from 195th Street and Happy Road to San Tan in 2005 and again in 2007, damaging roads, corrals, fences, driveways, stranding and trapping vehicles, and killing a horse.

Apache Junction/East Mesa, Maricopa County

- Baseline & Meridian—fissure crosses diagonally under the intersection, fissure zone over one mile long.
- Ironwood and Guadalupe—industrial facilities built on top of several fissures in the area; fissures stop immediately east of subdivision; fissures crossing powerlines.

Mesa, Maricopa County

- Loop 202 (Red Mountain Freeway)—fissure present at least since 1970s; attempted mitigation during construction cost $200,000.
- Sossaman Road and University Drive—fissure runs diagonally through a subdivision along the entrance; fissure known in 1973 and subsequently backfilled.

Picacho, Pinal County

- I-10—AZ Department of Transportation still trying to determine effective mitigation for the fissure crossing.
- Picacho Pump Station—fissure crosses access road and runs nearly to canal; damaged road in 1984.

Wintersburg, Maricopa County

- Fissure runs perpendicular to power transmission lines near Palo Verde Nuclear Generating Station; made one road impassable.

Scottsdale, Maricopa County

- CAP Canal—fissure paralleling the canal opened within a few feet of the lining on the east side in 2003.
- 40th St and Cholla—discovered in 1980s.

Flood retarding structures, Maricopa County

- McMicken Dam, White Tank Mountains—dam had to be removed and replaced; cost several million dollars.
- Powerline FRS, Apache Junction—fissure just discovered within 1200 feet of the FRS; Flood Control District examining mitigation options.

Avra Valley, Pima County

- CAP Canal—fissure discovered that nearly intersected the canal in 1988.

Willcox, Cochise County

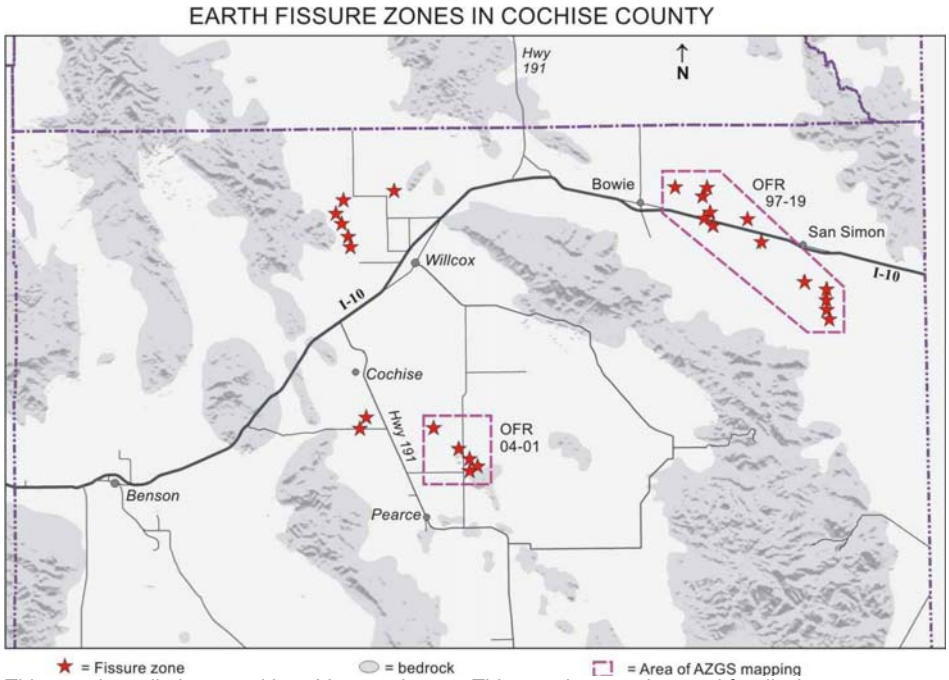
- Nickels Road—in 1984, a fissure opened down one side of the road near where it crosses power transmission lines.

Probability and Magnitude

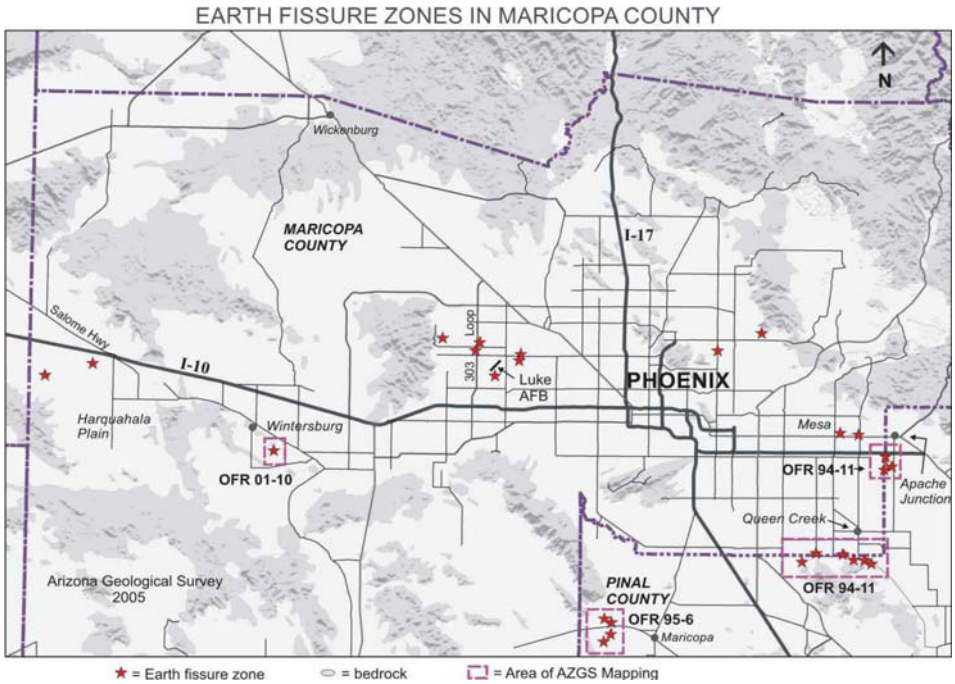
There are no methods of quantifiably predicting the probability and magnitude of earth fissures, but the locations of potential fissures may be predictable in specific areas if enough information about the subsurface, material properties and groundwater levels are available. However, as long as subsidence continues (even if the groundwater levels should rise and stabilize), fissures will continue to occur, and the magnitude of the fissures vary with the depth to groundwater, type of surficial material present, amount of groundwater removed, basin depth, volume of runoff from precipitation, and human intervention.

In an attempt to categorize the probability of future events of fissures, the hazard was analyzed using the CPRI. This method also takes into account the levels of magnitude/severity, warning time and duration. In Arizona, fissures are likely, the magnitude/severity is typically limited, the warning time would usually be less than 6 hours and the duration is usually less than 6 hours. This hazard was more challenging than others to rate due to being able to the possible predictability and duration can in some cases be incremental. However, these factors resulted in a CPRI rating of 2.65. The highest rating a hazard can result in using this method is 4.

Map 22 – Fissures

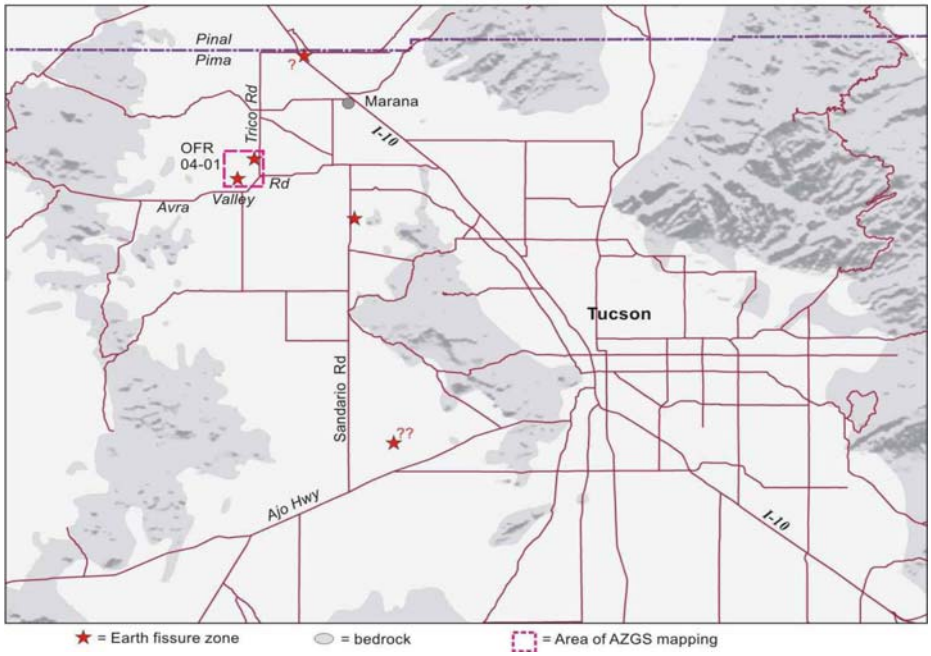


This map is preliminary and is subject to change. This map is not to be used for disclosure purposes. The AZ Geological Survey makes no warranties, expressed or implied with respect to the information in this map. Map version: January 2006.



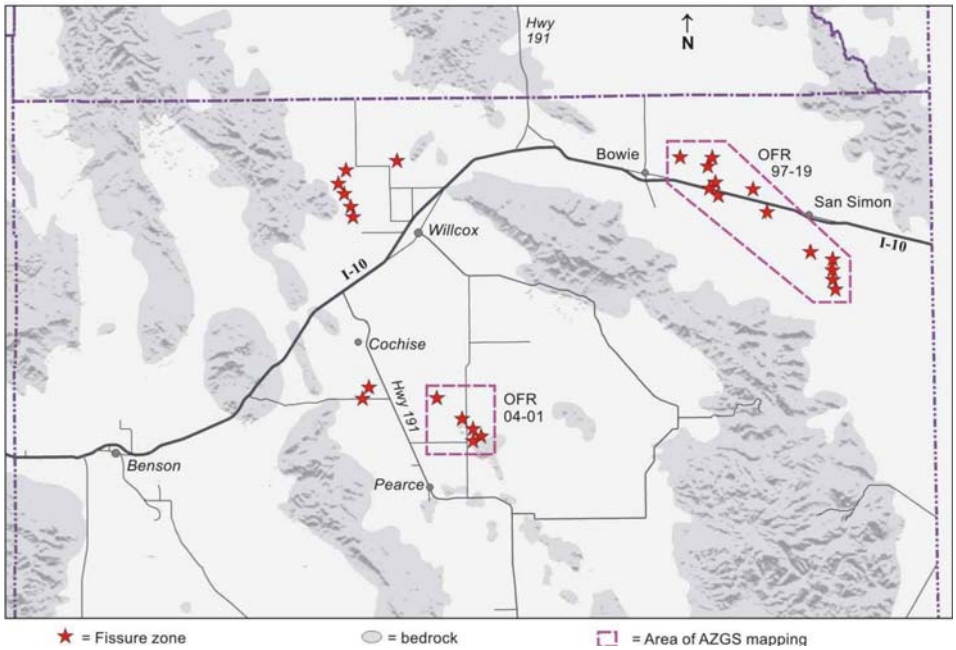
This map is preliminary and is subject to change. This map is not to be used for disclosure purposes. The AZ Geological Survey makes no warranties, expressed or implied with respect to the information in this map. Map version: January 2006.

EARTH FISSURE ZONES IN EASTERN PIMA COUNTY



This map is preliminary and is subject to change. This map is not to be used for disclosure Purposes. The AZ Geological Survey makes no warranties, expressed or implied with respect to the information in this map. Map version: January 2006.

EARTH FISSURE ZONES IN COCHISE COUNTY



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Vulnerability

The impacts of earth fissures due to subsidence can be economically devastating to developed local areas. During the periods of heavy rains, fissures can develop quickly through erosion and create a substantial hazard to people, buildings and infrastructure. Also, fissures provide a conduit for rain runoff to carry contaminated waters to underground aquifers.

For the local risk assessment summary, the table below combines asset and predominantly HAZUS information for the estimated losses as reflected in local plans. The potential total number of facilities in the inundation areas is 362,166 at a replacement cost of $20 billion. The estimated losses for subsidence/fissures are not available at this time.

Summary of Local Risk Assessment & loss estimates based on Subsidence/Fissure			
	Total Assets $ (Assets +HAZUS) x $1,000	# of Facilities Impacted (Assets + HAZUS)	Estimated Loss
Statewide Totals	$20,622,994	362,166	-----
Maricopa	-----	170,390	-----
Pima	$20,622,994	191,776	-----
----- Denotes lack of available information for assessment.			

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